me215 The Test
Fall 2020

name _____

cwid _____

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CHARTREUSE

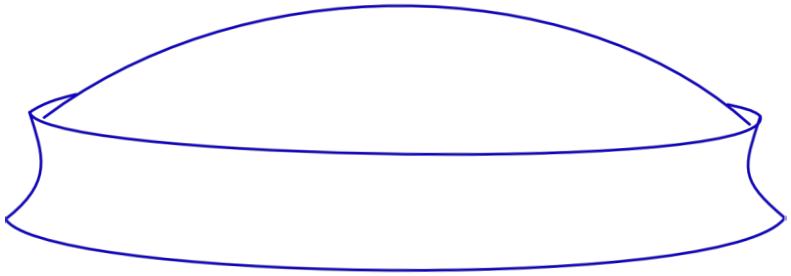
ME215: Thermodynamics I
The Test, 15-18 November 2020
35 Tasks — 305 points

Write your final answers on this problem sheet **AND** make sure your final answers are **clearly identified** in your work. Make sure you turn in **ALL** of your work sheets.

The **ONLY** resources you may use are your textbook, class notes, and me. Accessing your textbook is the only permitted use of the Internet or any other communication networks.

No Internet or communication allowed. Calculator is allowed.

RESOURCES



The Louisiana Superdome has an interior volume of 125 million ft^3, covered by a 440,000 ft^2 roof. On a particular day, the interior air pressure gave a manometer reading of 19 inches mercury. Local atmospheric pressure is 102 kPa.

1. _____ kg (10) Calculate the **mass of the air inside**, assuming an average temperature of 20 °C.

2. _____ kg (10) Calculate the **net force applied** to the roof by the interior/exterior air (do not account for the weight of the roof). Assume the roof is flat.

3. (15) Describe open, closed, and isolated systems, respectively. Be sure to highlight the differences between the three system types

_____

_____

_____

4. _____ (5) Krypton (P_1 = 2 MPa, T_1 = 600 K) is throttled to a pressure of P_2 = 1.2 MPa. Assuming ideal gas behavior, which of these statements describes the downstream temperature T_2?

   (a) $T_2 < T_1$ (b) $T_2 = T_1$ (c) $T_2 > T_1$

5. _____ (5) A fluid is at its critical point. The temperature is lowered while the pressure is held constant. What is the phase of the fluid after the change (as in superheated vapor, saturated mixture, etc)?

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A system consists of a **saturated liquid/vapor mixture**. Heat is **removed** from the system in an **isothermal** process**.**

6. _____ (5) The quality
   (a) increases (b) decreases (c) stays the same (d) not enough information

7. _____ (5) The temperature
   (a) increases (b) decreases (c) stays the same (d) not enough information

8. _____ (5) The pressure
   (a) increases (b) decreases (c) stays the same (d) not enough information

9. _____ (5) The specific volume
   (a) increases (b) decreases (c) stays the same (d) not enough information

A system consists of a **saturated liquid/vapor mixture**. Heat is **added** to the system in an **isochoric** process

10. _____ (5) The quality
    (a) increases (b) decreases (c) stays the same (d) not enough information

11. _____ (5) The temperature
    (a) increases (b) decreases (c) stays the same (d) not enough information

12. _____ (5) The pressure
    (a) increases (b) decreases (c) stays the same (d) not enough information

13. _____ (5) The specific volume
    (a) increases (b) decreases (c) stays the same (d) not enough information

Given 10 kg of ammonia at 0 °C, with a specific enthalpy of 1261.97 kJ/kg.

14. _____ kg (10) Find the **mass** of the ammonia.

15. _____ m^3 (10) Find the **volume** of the ammonia.

16. _____ m^3 (10) Find the **pressure** of the ammonia.

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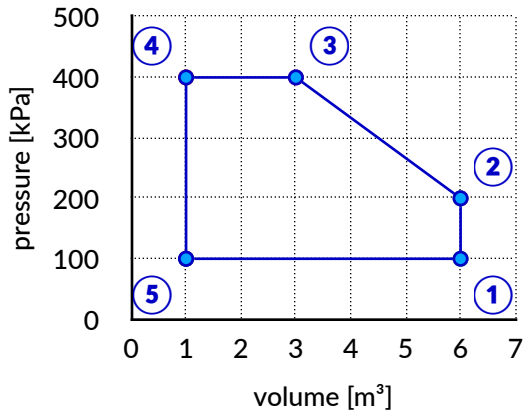
A vessel contains 3 kg of H_2O at 100 bar, 600 °C. Heat is lost from the vessel until the temperature reaches 200 °C.

17. _____ °C (10) Find the H_2O **final temperature**.

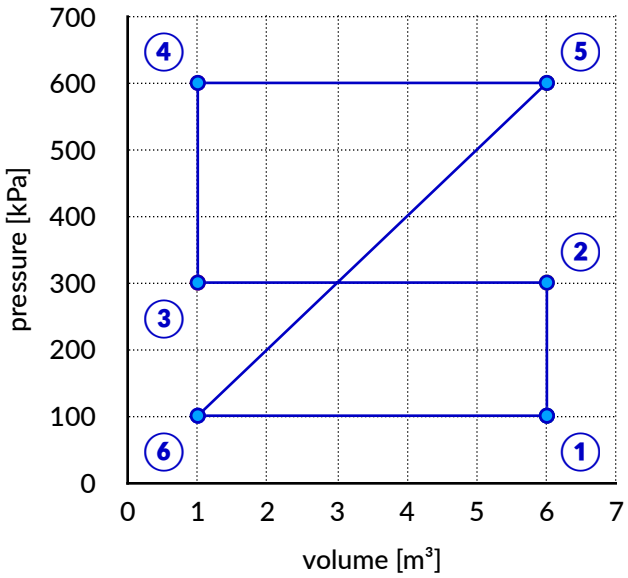
18. _____ kPa (10) Find the H_2O **final pressure**.

19. _____ $kJ_{in/out}$ (10) Determine the **heat transfer**, with direction.

20. _____ $kJ_{in/out}$ (10) Determine the **work**, with direction.



21. _____ $kJ_{in/out}$ (10) Determine the **net work** (and direction) of the cycle $\overline{123451}$ depicted above.



22. _____ $kJ_{in/out}$ (10) Determine the **net work** (and direction) of the cycle $\overline{1234561}$ depicted above.

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LEAPS

Steam at 280 bar, 900 °C enters a well-insulated turbine and exits at 10 kPa and 93.9% quality. The mass flow rate is 2.34 million kg/hr, and the turbine entrance has a diameter of 63 cm.

23. _____ °C (10) At what **temperature** does the H_2O exit the turbine.

24. _____ GW (10) What is the turbine's **power** output?

25. _____ GW (10) At what **velocity** does the steam enter the turbine?

A 10 kg mass of saturated vapor water, initially at 200 °C, is heated in a rigid container until its pressure doubles.

26. _____ °C (10) What is the final **temperature** of the H_2O?

27. _____ kPa (10) What is the final **pressure** of the H_2O?

28. _____ kW (10) What is the **work** for this process?

29. _____ kW (10) What is the **heat transfer** for this process?

30. _____ kg (10) What is the **final mass** of the H_2O?

A 10 kg mass of saturated vapor water, initially at 3 bar, is heated in a frictionless piston/cylinder device until its volume doubles.

31. _____ °C (10) What is the final **temperature** of the H_2O?

32. _____ kPa (10) What is the final **pressure** of the H_2O?

33. _____ kW (10) What is the **work** for this process?

34. _____ kW (10) What is the **heat transfer** for this process?

35. _____ kg (10) What is the **final mass** of the H_2O?

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